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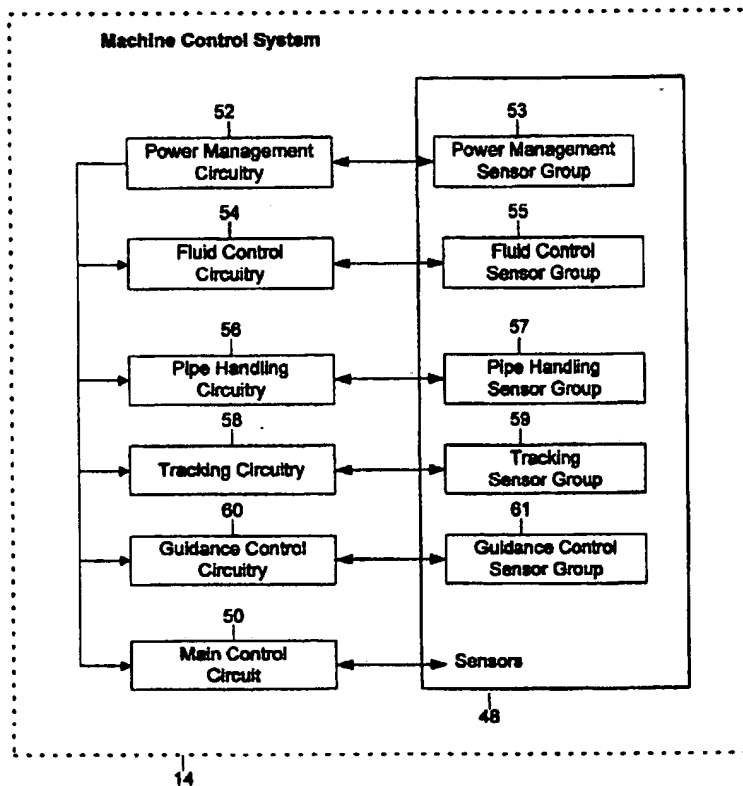
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(75) Inventors/Applicants (for US only): PAYNE, David, R. [—/US]; 1120-14th, Perry, OK 73077 (US). STANGL, Gerald, A. [—/US]; 1918 South Iba Drive, Stillwater, OK 74074 (US). STEVENS, Norman, E., Jr. [—/US]; 827 Holly, Perry, OK 73077 (US). GARD, Michael, F. [—/US]; 11601 Gunsmoke, P.O. Box 187, Perry, OK 73077 (US).
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- (30) Priority Data: 09/481,351 12 January 2000 (12.01.2000) US
- (71) Applicant (for all designated States except US): THE CHARLES MACHINE WORKS, INC. [US/US]; P.O. Box 66, 1959 West Fir Avenue, Perry, OK 73077-0066 (US).
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[Continued on next page]

(54) Title: SYSTEM FOR AUTOMATICALLY DRILLING AND BACKREAMING BOREHOLES



(57) Abstract: A system and method for automatically drilling and backreaming a horizontal borehole underground. The system includes a horizontal drilling machine and a machine control system for operating the drilling machine. The machine control system has sensors and control circuits for monitoring and automatically controlling the functions of the drilling machine. The machine control system manages the power consumption of the drilling machine, the fluid dispensed during drilling and backreaming, the lengthening and shortening of the drill string, the tracking and recording of progress along a selected bore path, and the guiding of the downhole tool along the selected bore path. In a drilling operation the method involves identifying a selected bore path and automatically guiding the downhole tool along the selected bore path. In a backreaming operation the method involves connecting a backreamer and a utility line to the drill string and automatically pulling the utility line back through the borehole.



NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM,
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INTERNATIONAL SEARCH REPORT

International Application No

PC1/US 01/00800

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B19/20 E21B19/16 E21B19/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 477 728 A (SALZGITTER MASCHINENBAU) 1 April 1992 (1992-04-01) column 1, line 1-13	1-3, 28-30
A	column 8, line 4 - line 9 column 8, line 28 - line 31 column 9, line 6 - line 19; figures 2,5 ---	4,31
Y	EP 0 565 502 A (NYMAN KARL ERIK) 13 October 1993 (1993-10-13) abstract; figure 1 column 9, line 17 - line 23 ---	1-4, 28-31
Y	US 4 604 724 A (SHAGINIAN ALBERT S ET AL) 5 August 1986 (1986-08-05) claim 1; figure 1 ---	1-4, 28-31
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

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Date of mailing of the international search report

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Bellingacci, F

INTERNATIONAL SEARCH REPORT

International Application No

PC JS 01/00800

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 829 614 A (POWERDRILL FRANCE ;GAZ DE FRANCE (FR)) 18 March 1998 (1998-03-18) column 3, line 40 - line 52	1,28
A	column 4, line 21 - line 30 column 11, line 21 - line 28 column 12, line 11 - line 32; figures 1,5 ---	2-4, 29-31
A	US 5 584 351 A (ELLCOTT JOHN) 17 December 1996 (1996-12-17) the whole document ---	1-4, 28-31
P,X	EP 0 984 132 A (CHARLES MACHINE WORKS) 8 March 2000 (2000-03-08) the whole document ---	1-5, 28-32
A	WO 95 25216 A (GJEDEBO JON ;HITEC AS (NO)) 21 September 1995 (1995-09-21) page 4, line 21 - line 26 ---	5,32
A	US 5 518 076 A (HOLZ JOHN F ET AL) 21 May 1996 (1996-05-21) abstract; figure 1 -----	5,32

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 01/00800

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-5, 28-32

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-5,28-32

Considering EP 0 477 728 A as closest prior art the subject-matter of claims 1-3 and 28 to 30 is not new. The special technical features of claims 4,5,31 and 32 are that the horizontal drilling system is provided with drill string length modification sensors which permit to automatically modify the length of the drill string.

2. Claims: 6,33,44-48

Horizontal drilling system provided with automated fluid dispensing means.

3. Claims: 7,9-27,34,36-43

Drilling system comprising means for automatically locating the position of a downhole tool and/or automatically steering it.

4. Claims: 8,35

Drilling system comprising an automatically managed power system.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/00800

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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